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AUTHOR Warren, Charles R.
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ABSTRACT

In the United States, women accounted for 44 percent of the workforce but only 15 percent of the science and engineering jobs during the 1980s. Traditional socialization from a number of different sources educates girls and women to believe that these non-traditional careers are not available to them. Several previous researchers have shown that one socializing force in schools is the image of scientists in science textbooks. The purpose of this study was to investigate the relationship between images of science careers and junior high school students' attitudes toward science occupations. Eight classes of students in grades 6 to 8 (n=211) were shown sex-biased collages of images. Four classes were shown pictures with a male bias, and the other four the opposite condition over 4 weeks in their science classes. Following treatment, students completed a questionnaire, a Draw-A-Scientist test, and a Q-sort of science occupations. It was shown that: (1) student background characteristics were significant predictors of Q-sort scores; (2) there were significant differences between the treatment groups; and (3) the treatment was more effective for the girls in the sample than for the boys. A questionnaire, a sample collage, and protocols for the Draw-A-Scientist Test and the Q-sort are included. (CW)

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An Exploration of Factors Influencing the Career Preferences of Junior High Students

Charles R. Warren
Department of Educational Studies
Science Education
The Ohio State University
Columbus, Ohio
April 6, 1990

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Introduction

A 1988 National Science Foundation report (NSF, 1988), Women and Minorities in Science and Engineering, indicated serious inequities in the representation of women in science and engineering. Although women constituted 44% of the labor force in 1986, they held only 15% of all engineering and science related positions. Specifically, 88.6% of the physical science, life science, computer science, environmental science, mathematics, and engineering jobs involving teaching, production, inspection, reporting, analyzing or computing and requiring at least a bachelors degree are held by men. Though males make up only 49% of the population of the United States, they dominate employment in science and engineering fields (Malcom, 1984). This cannot be completely accounted for by hiring practices among employers. Part of the problem lies in the numbers of women in the pool of potential scientists from which employers draw. Though women represent 52% of all students taking the Scholastic Aptitude Test (SAT) and academic enrollment of boys and girls in U.S. high schools is essentially equal, 48% of boys report plans to pursue a career in science and engineering and only 28% of the girls report such intentions (Malcom, 1984). With the steady increase in the amount of science and technology in people's lives, it is increasingly necessary for science educators to concentrate on scientific literacy and participation in science (Crosby, 1988).

Berger (1977) states that through traditional socialization, women are being prepared for an inappropriate and dysfunctional role in society. A majority of women are required to find employment to support themselves and their families (Corcoran, Duncan & Ponza, 1984), yet they are socialized to be ineffective in careers, especially those in science and technology fields which provide the best pay and highest prestige. The disparity between what women are socialized to do and what is economically demanded of them is evidenced by the fact that a majority of women are concentrated in fields of employment with low wages and few promotional opportunities compared with men (Fox & Hesse-Biber, 1984). Women are

overrepresented in clerical, sales, service, teaching, nursing, social work, and medical and dental technology while men are overrepresented in managerial, craft, labor, professional and technical careers (Marini & Brinton, 1984). This means that a great deal of human capacity which is needed in ever-growing science and technology fields, is going unutilized.

According to Marini and Brinton (1984), the sex difference in obtaining training for jobs in science and mathematics is directly related to the imbalance seen in careers. The lack of scientific training prevents women from majoring in the sciences in college and entering the science career pipeline. Through the process of traditional socialization, young women are led to believe that science and mathematics courses hold little relevance for their lives and their future roles. As a result, they enroll in science courses less frequently than their male peers and, once in, tend to withdraw more quickly (Lovely, 1987). This pattern prevents them from receiving the necessary training and effectively filters them from the science pipeline.

Sex differences have been shown by several studies to be the result of socialization rather than biology (Marini & Brinton, 1984). Occupational stereotyping begins early in a child's life (Umstot, 1980), and works gradually through a lifetime of learned experiences (Krumboltz, Mitchell & Jones, 1976). The schema brought to a situation by an individual largely governs what is learned from any situation. The socialization process creates the gender aspect of a child's schema and therefore their stereotyped images of careers (Marini & Brinton, 1984). The earliest influence on this schema occurs in the home setting. Parents are models of career appropriateness (Bandura & Huston, 1961). Most parents are involved in stereotypical roles whether in the home or in the workplace. As a result, the earliest view of careers that children have is strictly governed by stereotyped notions of what constitutes male and female jobs (Cummings & Taebel, 1980). Preschool girls tend to have a stereotyped but limited view of available careers. Boys at this age apply their stereotyped attitudes to a wider range of careers (Marini & Greenberger, 1978). Few studies

have examined the developmental change in these attitudes, though existing results agree that girls' and boys' attitudes are consistent over the elementary school years (Schlossberg & Goodman, 1972).

Developmental theories of occupational choice suggest that at around age 14, orientation to the internal, unique self begins (Poole & Cooney, 1985). Gottfredson (1981) states that, in adolescence children turn to their personal attitudes and sense of career availability to make decisions about career and personal goals. He further states that social-environmental constraints and supports such as sex and social class operate in the process of career choice at this age. There is evidence that, late in the elementary years and into junior high, young women begin to allow more latitude in the types of occupations considered appropriate for boys and girls (Cummings & Taebel, 1980). This appears to be a brief period of change. Marini and Brinton (1984) indicate that from ninth grade through high school, stereotyped attitudes are again more common. Sinclair, Crouch, and Miller (1977) found that high school girls were highly constrained as to their career aspirations by their sex role socialization. In summary, while males are consistent in their sex-stereotypical attitudes concerning occupations, females seem to experience a period of flexibility in their attitudes concerning the sex-appropriateness of careers.

Need for Study

Some researchers have indicated that the educational system itself contributes to children's stereotypical notions of careers (Walford, 1983; Bertilson, Springer, & Fierke, 1982). Throughout their educational careers, students are bombarded with the message, also pervasive in other areas of society, that occupational aspirations and opportunities as well as lifestyles are determined by gender. These expectations and beliefs effect the educational and career goals of young women, causing them to avoid areas of high competition and prestige such as science and technical fields (Britton, 1973).

Kelly (1985) states that one way science can be made to appear masculine is through

packaging; that is, the way science is presented in classroom materials including the images in textbooks. In science classrooms, instruction is dominated by the textbooks that are selected for use by the students (Goodlad, 1984; Weiss, 1987). Though little is known about the effects of sex stereotypical materials on children's attitudes and occupational aspirations (Marini & Brinton, 1984), it is believed that the images of men and women in textbooks can be very influential in the attitudes of school children and can help to reproduce the structure of the society (Walford, 1980; Cohen and Cohen, 1980). Descriptive studies have shown that the illustrations in science textbooks can support traditional sex role stereotypes or, by representing women as active participants in science they can encourage female students to participate equally with their male peers. A study of the most popular textbooks used in schools found that sex stereotyping increased with grade level and that the highest degree of stereotyping was found in science textbooks. Several have indicated that earth science (Warren, 1989), physics (Walford 1980, 1981, 1983; Kelly 1975; and Taylor 1979) and chemistry (Heikkinen, 1978) textbooks support the stereotype of the physical sciences as exclusively masculine in nature. Studies of biology textbooks and elementary science series (Warren, 1989; Warren & Rogers, 1988) arrived at similar conclusions. Many publishers have issued guidelines for the elimination of one-sided or sexist portrayals of men and women in their materials (Britton & Lumpkin, 1977; Weston & Stein, 1978; Warren, 1989), yet some researchers feel that the newer texts lack significant improvement (Bertilson, Springer, & Fierke, 1982; Warren, 1989).

Purpose

The purpose of this study is to investigate the relationship between images of science careers and junior high school students' attitudes toward science occupations when background characteristics have been accounted for. It will be shown that the family characteristics are the strongest forces effecting a child's attitude but that the bias of school factors, which is easier for educators to manipulate, can be used to alter the sex appropriateness

attitudes of the young people in the sample.

Hypotheses

1. Having been exposed to representations of science careers which have a skewed sex balance, the girls in the classes which were exposed to the female-bias will indicate higher interest in nontraditional science occupations than the girls in the opposite condition.

2. There will be no difference in the amount of interest expressed by boys in the two treatment groups.

3. Characteristics of parents such as education and occupation will be the strongest predictors of science occupation interest scores.

4. The treatment group will be a significant predictor of science occupation interest scores.

5. Scientists will be represented as males more often in the drawings of boys than in the drawings of girls, indicating a more stereotyped view of science careers among boys.

Research Design

Population: Two classes from each of four junior high science teachers were used in this pilot study (eight classes, 211 students). Two different school districts were involved. The teachers included one black female, one white female, and two white males. Four of the classes were in an urban setting, four suburban. The urban classes included two eighth grade life science classes and two seventh grade earth science classes. The suburban classes were sixth grade general science classes. Within each school, the classes were randomly assigned to treatment groups. Four classes, 105 children, received materials with a female emphasis and the other four, 106 children, received materials with a male emphasis. The number of boys and girls in each treatment group were roughly equal. A detailed description of the characteristics of each group can be found in Table 1.

Procedure: Every other day for four weeks, each student was given a sex-biased collage representing a science career by their science teacher. The pictures used to assemble these collages were selected from caricatures found in Children's Dictionary of Occupations (Hopke & Parramore, 1987). One of each teacher's classes received a collage which used pictures

of males and females in science careers at a ratio of 4:1 and the other class was given a collage which used pictures males and females in science careers at a ratio of 1:4. The students in these school districts were originally placed in these classes by random assignment. In order to be certain that each student viewed the pictures, they were be instructed to look at all of the pictures, circle their favorite and return the page to the teacher. Careers depicted included chemist, biologist, physicist, geologist, doctor, nurse, veterinarian, lab technician, medical assistant, and engineer. Neither the careers nor the collages were not be discussed with the children by their teacher. An example of a collage for each treatment group is presented in Appendix A.

Instrumentation: This is a posttest only design (after Campbell and Stanley, 1963) because of the high probability of pre-posttest interaction in attitude measures. After the tenth illustration was presented, each student completed a background questionnaire (Appendix B) to collect personal characteristics of each student. These characteristics included age, sex, grade level, race, adults living in the home, number of children and birth order, parents' education and occupation, expected grade in science, and attitude about school subjects. The variables were coded as follows: Sex, male-female; race, black-white-other; parent's education, college-less; parent's occupation, traditional-nontraditional; expected grade in science, A-B-C-D-F. At the end of the questionnaire, each child was directed to answer to the question "What do you want to be when you grow up?" Students then completed a forced Q-sort (McKeown & Thomas, 1988) in which each science career shown during the treatment period plus biology and physics teacher was placed into an interest category; high, medium, low, or none (Appendix C). Students were forced to place three occupations into each category. These science occupation interest scores were used as the dependent variable in the analysis. The independent variable was the treatment group. It was noticed during the sorting exercise that some of the children were unsure of the meaning of the terms biologist, geologist, and physicist. Generic definitions were given in each class. This was the first

indication that children this age would need more instruction in order to make a valid appraisal of these occupations.

Following the sorting of occupations, each child was given seven minutes to think of their mental picture of a typical scientist and draw it on the back of their questionnaire (Appendix C). The sex of their response to the Draw-A-Scientist Test (DAST) (Chambers,1963), coded male-female-neutral, was used as a measure of each child's attitude of the sex stereotype of science and used as a background variable.

Results

An accounting of the choices made by boys and girls in their respective treatment groups was made. If the pictures were chosen at random, it would be expected that the lone female in the male emphasis collages would be chosen 20% of the time. The same would be expected for the lone male in the female emphasis collages. It was found that in the male emphasis treatment group, boys chose pictures of males more than 80% of the time (an average of 88%), while girls chose males more at random (an average of 76%). In the female treatment group, girls chose females nearly at random (an average of 81% of the time) while the boys more frequently chose males (an average of 32% of the time) (Table 2). This seems to indicate that the sex stereotypes of science careers of the boys in the sample were stronger than the girls'.

In response to the question "What do you want to be when you grow up?", the children reported a wide variety of occupations (Table 3). For girls, the most popular occupations were lawyer (15) and doctor (8). Thirty-four per cent of the girls reported wanting a career in science. The most popular careers for boys were sports (18). Desire to work in a science field was reported by 32% of the boys.

The means and standard deviations of the occupational interest scores are reported in Table 4 for males and females by treatment group. For both boys and girls, the occupations of teacher, geologist, and physicist were rated consistently low with the teachers being the lowest. For the boys, engineering and lab technician were rated the highest followed by chemist doctor and veterinarian. Nursing received the lowest rating from boys. For the girls, nurse and doctor were rated the highest followed by veterinarian, medical technician and chemist. Girls rated biology teacher the lowest. From these results it can be assumed that nursing is the most highly stereotyped occupation of this group. Engineering also appears to be sex-stereotyped by this sample of children.

When asked to think of and draw their image of a typical scientist, boys tended to draw

men while the images of girls were mixed. Of the boys, 91 (85.8%) of them drew males while only four (3.8%) of them drew females. Ten of the boys drew figures whose sex was ambiguous and one drew an alien being. Of the girls, 44 (43.6%) of them drew males and 42 (41.6%) of them drew females. Though none of the girls drew aliens, 15 (14.9%) of them drew figures whose sex was ambiguous. Other notable items in their drawings were scenes showing experimentation on animals or human subjects and frequently persons performing experiments with chemicals. Most children drew scientists wearing lab coats and only two drawings showed scientists working outdoors. These results did not vary over the different treatment groups. The sex of these drawings was coded for use in later analyses. Regression analyses were used to predict the occupational interest scores assigned to each of the 12 science occupations that were evaluated by the students. The regression model in these analyses included child's sex, child's race, treatment group, mother's education and occupation, father's education and occupation, school location, teacher's sex, teacher's race, students' expected grade in science, mother's employment outside of the home, and the child's sex-stereotype of a scientist to predict the occupational interest scores. This model was employed separately for each of the science occupations. The model explained from 5 to 53% of the variance in the occupational interest scores for each of the 12 occupations.

The central variable, treatment group, was a significant predictor of the occupational interest scores for the occupations of lab technician and chemist, controlling for the effects of the other variables. In each case treatment group was positively related to the interest score. The children in the group who were exposed to a female emphasis rated these occupations as more desirable than the children exposed to the opposite condition. The strongest predictor of the occupational interest scores for 10 of the occupations was the sex of the child. This variable was not a significant predictor of the interest scores for the occupations of physics teacher and biology teacher. The sex of the child was positively

related to the interest scores for biologist, geologist, physicist, lab technician, engineer and chemist and was negatively related to the scores for veterinarian, medical technician, doctor and nurse. This relationship indicates that boys rated the former occupations as more desirable than girls did. The other variables were inconsistent in their effects on the occupational interest scores.

Mother's level of education was significantly positively related to the occupational interest scores for lab technician and significantly negatively related to the teacher occupations. This means that the children of mothers who have a college education scored lab technician as a desirable career and had no desire to teach. Father's level of education was significantly positively related the teaching occupations and significantly negatively related to lab technician. This means that father's education had the opposite effect of mother's education. The student's expected grade in science was significantly, positively related to the interest score for geologist, and negatively related to veterinarian. Children with higher science grades tend rate geology as a desirable career and veterinarian as a non desirable career. Mother's occupation was significantly negatively related to the interest score for geologist. Children whose mothers were employed in non-traditional occupations expressed low interest in the occupation of geologist.

Race was significantly positively related to the scores for veterinarian; white children tend to rank veterinary medicine as a desirable occupation. Suburban children expressed less interest in physics as a career than urban children. The children who drew a male scientist rated the occupation of doctor as more desirable and the occupation of geologist as less desirable than children who drew female scientists.

A fixed block, multivariate analysis of variance was performed using the matrices of occupational interest scores as dependent variables and using sex as the blocking variable to account for its effect (Table 5). It was found that the main treatment group effect for the entire sample was significant (T^2=.152) though the direction of the result was ambiguous.

For boys taken separately (Table 6), the treatment group effect was nonsignificant although separate significant effects were seen for lab technician and chemist scores. In both cases, the boys in the female emphasis treatment group tended to rate these occupations as more desirable than others. For girls taken separately (Table 7), the treatment group effect significant (T^2=.233) and separate significant effects were seen on the lab technician and biology teacher scores. Girls in the male treatment group rated lab technician lower and biology teacher higher than girls in the female treatment group. These ambiguous results indicate that there may be other effects from the pictures which have gone unaccounted for. It is clear that there was a significant treatment group effect at work in this analysis.

Limitations

There was indication that there is more information available to explain the effects of illustrations on the science attitudes of children. Because of the costs involved in the production of the collages for this study, little attention was given to the content of the picture other than sex. Because no other information about the careers in question was given, some of the ambiguous results may be attributed to a lack of knowledge of career characteristics on the part of the children. It seems apparent that the level of activity in the pictures conveyed some information as well. For example, the results for geology were driven partly by the amount of outdoor activity shown in the illustration given to one treatment group. This confounding effect from the variety of activity shown in the pictures and the lack of career awareness of the children has weakened the treatment group effects shown by this study. It is encouraging that these effects were still strong enough to show significance through this interference.

Because of the underrepresentation of non-white races among the children and the teachers in the sample, it is difficult to estimate the effect of race on the occupational interest of students with any confidence. Race will be an important consideration in future studies.

The education level and occupational category of the parents should be measured in more detail and retained since they did have some explanatory power. Another important variable to be retained for later use is the child's perception of their ability in science as measured by their expected science grade.

In think-aloud interviews held with two of the students, an additional effect became apparent. One of the students, a boy, relied heavily on the illustrations to get the meaning from the text being read. He reported being confused when the pictures did not match his perceptions. Another student, a girl, spoke of being distracted by the pictures and said that she preferred books without pictures. From these interviews, it can be concluded that the reading strategies used by different children should be considered in future studies.

Conclusions

The results of this study lead to a number of conclusions regarding the factors which effect the career preferences of school children. The results of an analysis of the pictures chosen by the children at each step of the treatment support the work of Cummings and Taebel (1980). The girls in this study did have a more liberal view of the types of occupations acceptable for women. Their choices did not tend to be sex stereotyped to the extent that the boys' attitudes were. The girls in this sample did not however have a narrower range of careers in mind than the boys. They reported desires for more different kinds of careers than did the boys in this sample. The careers reported by boys tended to include only stereotypical male types while the girls reported desires to enter more nontraditional fields such as lawyer and engineer. These occupations are high prestige jobs that have usually been reserved for the boys. This finding indicates that junior high school aged girls are a good target for nontraditional career education since they will consider nontraditional careers more readily than boys their age.

There are still some careers that are sex stereotyped and resistant to change on the magnitude of this study. Nursing is a career for women according to this sample of children. Engineering was shown to be more for men although not as strongly. The low status of teaching was pointed out vividly in this study. Teaching was consistently rated as the least desirable occupation by most of the children regardless of sex. The picture of a scientist in the mind of nearly all of the boys was male. For girls, this message is different. They are just as likely to have a view of science as a female endeavor as they are to see science as male. This view was not the result of the experimental treatment but rather an expression of the schema that has developed in their minds at this point in their lives.

The results of the regression analysis are more ambiguous. The sex of the children was the most important predictor of the occupational interest scores. The other variables explained small amounts of the variation in the scores. The strength and prevalence of the

effect of child's sex and the relative weakness of the other variables indicates that socialization effects may be masked in the measure of child's sex. The measurement of the effects of the background variables in this study has been unable to separate them from the attitudes toward science held by each sex.

The most encouraging results form this study are the significant treatment group effects detected by the multivariate analysis. This study has shown that when the strong effects of a child's gender are accounted for, there was still a difference between the two groups of children. Even in as short a time as four weeks and only ten pictures of people in science careers, the sex-bias of the career illustrations produced a slight but significant change in the career appropriateness attitudes of the children in the study. The hypothesized difference between girls in the two treatment groups at the end of the study has been supported as well as the hypothesized lack of change for the boys.

Implications

There are important implications which can be drawn from this research. This study has shown that the illustrations of men and women in science careers do have an effect on the science career attitudes of children. This being the case, it is important that teachers actively present a balanced view of science careers for boys and girls. Since the textbooks currently in use are male-biased, this means that teachers cannot rely on science textbooks alone for science career education. This effect is probably stronger when additional career information is given with the pictures. Teachers should take an active role in the career education of all of their students.

An important finding of this research is that the attitudes of the boys in science classes are more stereotyped and resistant than those of the girls. This means that it is at least as important for teachers to present nontraditional images of science careers to the boys in their classes. The boys are the future classmates, coworkers, employers and employees of the girls that choose science careers for themselves. It will continue to be difficult for women to succeed in science careers if attitudes of the men involved do not also change.

Finally, this research supports the view that children in the middle schools and junior high schools are the best targets for career education. Since educators can have little or no effect on the schema developed at the preschool level, the next best time is in early adolescence. If teachers wait until high school to begin career education, it may be too late to have an effect on children's attitudes in time to prepare them for science careers. Accommodations made to counter traditional socialization patterns and encourage equity in children's attitudes toward the involvement of women in science careers must be made before a child's high school track is chosen.

Bibliography

Bandura, A. & Huston, A.C. (1961). Identification as a process of incidental learning. *Journal of Abnormal and Social Psychology, 63*, 311-18.

Berger, G. (1977). The socialization of American females as a dysfunctional process: Selected research. *Journal of Research and Development in Education, 10*,3-11.

Bertilson, H., Springer, D., & Fierke, K. (1982). Underrepresentation of female referents as pronouns, examples and pictures in introductory college textbooks. *Psychological Reports, 51*,923-931.

Britton, G. (1973). Sex stereotyping and career roles. *Journal of Reading, 17*,140-148.

Britton, G. & Lumpkin, M. (1977). *For sale: Subliminal bias in textbooks.* (ERIC Document Reproduction Service No. ED 140 279).

Campbell, D.T. & Stanley, J.C. (1963). *Experimental and Quasi-experimental Designs for Research.* Chicago: Rand McNally.

Chambers, D.W. (1983). Stereotypic images of the scientist: The draw-a-scientist test. *Science Education, 67*, 255-265.

Cohen, R.F., & Cohen, M.R. (1980). Opening new doors: Taking sex role stereotyping out of science and mathematics. *School Science and Mathematics, 80*(7), 566-572.

Corcoran, M., Duncan, G., & Ponza, M. (1984). Work experience, job segregation, and wages. In B. F. Reskin (Ed.) *Sex segregation in the workplace: Trends, explanations, remedies*, (pp. 171-191). Washington, DC: National Academy Press.

Crosby, T. (1988). Minorities: Underrepresentation, education, and careers in science. *Journal of College Science Teaching, 17*(5), 342-343.

Cummings, S. & Taebel, D. (1980). Sex inequality and the reproduction of consciousness: An analysis of sex-role stereotyping among children. *Sex Roles, 6*, 631-44.

Ethington, C.A., & Wolfle, L.M. (1988). Women's selection of quantitative undergraduate fields of study: Direct and indirect influences. *American Educational Research Journal. 25*(2), 157-175.

Fox, M. & Hesse-Biber, S. (1984). *Women at work.* New York: Mayfield Publishing Co.

Goodlad, J.I. (1984). *A place called school.* New York: McGraw-Hill Book Co.

Gottfredson, L.A. (1981). Circumscription and compromise: A developmental theory of occupational aspirations. *Journal of Counseling Psychology Monograph, 28*(6), 545-579.

Heikkinen, H. (1978). Sex bias in chemistry texts: where is the women's place. *The Science Teacher,45*(1),16-21.

Hopke, W.E. & Parramore, B.M. (1987). *Children's Dictioary of Occupations*. Bloomington, Ill.: Meridian Educational Corp.

Jones, G. & Wheatley, J. (1988). Factors influencing the entry of women into science and related fields. *Science Education, 72*(2),127-142.

Kahle, J.B. & Lakes, M.K. (1983). The myth of equality in science classrooms. *Journal of Research in Science Teaching, 20*(2), 131-140.

Kelly, A. (1975). *Women in physics and physics education. International Conference on Physics Education*. Einhofen, The Netherlands: Einhofen University.

Kelly, A. (1985). The construction of masculine science. *British Journal of Sociology of Education, 6*, 133-154.

Kelly, A. (1988). The customer is always right...girls' and boys' reactions to science lessons. *School Science Review, 69*(249), 662-676.

Krumboltz, J.D., Mitchell, A.M., & Jones, G.B. (1976). A social learning theory of career selection. *Counseling Psychologist, 6*, 71-80.

Lovely, R. (1987). *Selection of undergraduate majors by high ability students: Sex differences and the attrition of science majors*. Paper presented at the annual conference of the Association for the study of Higher Education, San Diego, California.

Malcom, S. (1984). *Equity and excellence: Compatible goals*. Washington, DC: The American Association for the Advancement of Science (Pub 84-14).

Marini, M.M. & Brinton, M.C. (1984). Sex typing in occupational socialization. In B. F. Reskin (Ed.) *Sex segregation in the workplace: Trends, explanations, remedies*, (pp. 192-232). Washington, DC: National Academy Press.

Marini, M.M. & Greenberger, E. (1978). Sex differences in occupational aspirations and expectations. *Sociology of Work and Occupations, 5*, 147-178.

McKeown, B. & Thomas, D. (1988). *Q Methodology*. Beverly Hills: Sage Publications.

National Science Board Commision on Precollege Education in Math, Science, and Technology. (1984). *Educating americans for the 21st century*. Washington, DC: US Government Printing Office.

National Science Foundation, (1988). *Women and minorities in science and engineering*. Washington, DC: U.S. Government Printing Office.

Poole, M.E. & Cooney, G.H. (1985). Careers: Adolescent awareness and the exploration of possibilities for self. *Journal of Vocational Behavior, 26*, 251-263.

Powell, R. & Garcia, J. (1985). The portrayal of minorities and women in selected elementary science series. *Journal of Research in Science Teaching, 22*(6), 519-533.

Schlossberg, N.K. & Goodman, J. (1972). A woman's place: Children's sex stereotyping of occupations. *Vocational Guidance Quarterly, 20*, 266-270.

Scott,K.P. & Feldman-Summers, S. (1979). Childrens' reactions to textbook stories in which females are portrayed in traditionally male roles. *Journal of Educational Psychology, 71*(3), 396-402.

Sinclair, K.E., Crouch, B. & Miller,J. (1977). Occupational choices of Sidney teenagers: Relationships with sex, social class, grade level, and parent expectations. *Australian Journal of Education, 21*, 41-54.

Taylor, J. (1979). Sexist bias in physics textbooks. *Physics Education, 14*(5), 277-280.

Umstot, M.E. (1980). Occupational sex-role liberality of third-, fourth-, fifth-, and seventh-grade females. *Sex Roles, 6*, 611-618.

Walford, G. (1980). Sex bias in physics textbooks. *School Science Review, 62*, 219.

Walford, G. (1981). Tracking down sexism in physics textbooks. *Physics Education, 16*(5), 261-265.

Walford, G. (1983). Science textbook images and the reproduction of sexual divisions in society. *Research in Science and Technology Education, 1*(1), 65-72.

Warren, C. (1989, April). *Science textbooks and their subliminal messages for students*. Paper presented at the 1989 National Science Teachers Association National Convention, Seattle, Washington.

Warren, C. & Rogers, S. (1988, October). *Evidence for the lack of sexism in biology textbooks: A mistaken impression*. Paper presented at the 1988 Columbus Area Convention: National Science Teachers Association, Columbus, Ohio.

Weiss, I. (1977). *Report of the 1977 national survey of science, mathematics and social studies education*, Research Triangle Park:Research Triangle Institute.

Weiss, I. (1987). *Report of the 1985-86 national survey of science and mathematics education*. Research Triangle Park:Research Triangle Institute.

Weston, L. & Stein, S. (1978). A content analysis of publishers' guidelines for the elimination of sex-role stereotyping. *Educational Researcher, 7*(3),13-14.

Table 1. Descriptive Characteristics by Treatment Group

Treatment	n	School	Teacher Sex	Mean Class Size	Sex	Grade	Race	Parent's Education	Mother's Employment
Female Emphasis	105	Urban 48	Male 55	26.6	Male 54	6 57	Black 34	Mother	At Home 15
						7 21	White 66	College 70	Away 90
		Suburban 57	Female 50		Female 51	8 27	Other 5	Less 35	
								Father	
								College 74	
								Less 27	
Male Emphasis	106	Urban 50	Male 57	27.1	Male 54	6 56	Black 32	Mother	At Home 18
						7 20	White 68	College 70	Away 88
		Suburban 56	Female 49		Female 52	8 30	Other 6	Less 36	
								Father	
								College 72	
								Less 33	

Table 2. Picture choices During Treatment

Male Emphasis Treatment Group

	Male Choices		Female Choices	
Career Pictured	% Male	% Female	% Male	% Female
Biologist	83	17	58	42
Geologist	79	21	78	22
Physicist	89	11	77	23
Veterinarian	86	14	83	17
Med. Technician	100	0	94	6
Lab Technician	95	5	67	33
Engineer	78	22	76	24
Chemist	86	14	92	8
Doctor	89	11	86	14
Nurse	97	3	53	47
Average	88	12	76	24

Female Emphasis Treatment Group

	Male Choices		Female Choices	
Career Pictured	% Male	% Female	% Male	% Female
Biologist	68	32	44	56
Geologist	38	62	41	59
Physicist	22	78	9	91
Veterinarian	33	67	21	79
Med. Technician	47	53	24	76
Lab Technician	3	97	14	86
Engineer	5	95	9	91
Chemist	30	70	3	97
Doctor	28	72	14	86
Nurse	44	56	6	94
Average	32	68	19	81

Table 3. Career Desires of Children in the Sample

Girls	number	Boys	number
Lawyer	15	Sports	18
Doctor	8	Engineer	7
Business	7	Military	5
Nurse	6	Scientist	5
Service Occ.	4	Art	5
Medical	3	Doctor	5
Designer	3	Lawyer	4
Journalism	3	Business	3
Performance	3	Computer	2
Art	3	Architect	2
Lab Technician	2	Veterinarian	2
Veterinarian	2		
Engineer	2		
Military	2		
Biologist	1		
Hotel Manager	1		
Model	1		
Missionary	1		
Gymnast	1		
Teacher	1		
Architect	1		
Pipefitter	1		

Table 4. Means and Standard Deviations of Occupational Interest Scores by Treatment Group and Sex

Career	Male Emphasis Treatment Group				Female Emphasis Treatment Group			
	Males		Females		Males		Females	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Biologist	2.72	.90	2.31	.88	2.44	.90	2.08	.82
Geologist	2.28	.98	1.94	.94	2.65	1.10	1.88	1.01
Physicist	2.32	.95	2.00	.84	2.26	.89	2.04	.77
Veterinarian	2.83	1.30	3.35	1.01	2.59	1.09	3.08	1.13
Med. Tech.	2.44	.84	3.23	.88	2.30	.98	3.16	.90
Lab. Tech.	2.87	1.01	2.23	1.02	3.33	.78	2.88	.74
Engineer	3.35	1.01	2.10	1.14	3.30	.92	2.37	1.11
Chemist	2.87	1.03	2.39	.99	3.32	.87	2.69	1.01
Doctor	3.20	1.07	3.37	.88	2.96	1.16	3.27	1.08
Nurse	1.52	.86	3.42	.87	1.43	.72	3.14	1.11
Bio. Teacher	1.85	.88	1.83	.81	1.72	.74	1.53	.64
Phys. Teacher	1.70	.82	1.87	.97	1.74	.94	1.88	1.05

Table 5. Treatment Group by Sex Multivariate Analysis of Variance.

Source	Hypothesis DF	Error DF	T^2	Exact F	p
Treatment	12.00	196.00	.152	2.49	.005
Sex	12.00	196.00	1.366	22.31	.000
Treat.x Sex	12.00	196.00	.040	.65	.798

Table 6. Treatment Group MANOVA on the Sample of Boys.

Source	Hypothesis DF	Error DF	T^2	Exact F	p
Treatment	12.00	95.00	.174	1.39	.186

Table 7. Treatment Group MANOVA on the Sample of Girls.

Source	Hypothesis DF	Error DF	T^2	Exact F	p
Treatment	12.00	90.00	.233	1.74	.069

Appendix A

An Example of Sex-Biased Collages

1. Male Bias

2.Female Bias

Have You ever Considered a Career as a Chemist?

Have You Ever Considered a Career as a Chemist?

Appendix B

Student Background Questionnaire

BACKGROUND DATA

ID NUMBER _____

Please Circle the Best Answer
to Each Question Below.

1.	Age at last birthday:	9 10 11 12 13 14 15 16 17
2.	Sex:	Female Male
3.	Grade in school:	6 7 8 9 10 11 12
4.	Race:	Asian Black Mexican Puerto Rican White Other
5.	I live with: (Circle all that apply)	Father Mother Foster Parents Grandparents Stepfather Stepmother Other Relatives Other Arrangements
6.	Number of Children in your family (including you):	_____
7.	Child you are:	1st 2nd 3rd 4th 5th other
8.	Mother's highest grade in school:	6 7 8 9 10 11 12 College
9.	Father's highest grade in school:	6 7 8 9 10 11 12 College
10.	Mother's Occupation:	_____
11.	Father's Occupation:	_____
12.	Typical Grade in Science:	A B C D F

Please Tell me how you feel about each of the following subjects:

Art	Like	Dislike
English	Like	Dislike
Math	Like	Dislike
Music	Like	Dislike
Physical Education	Like	Dislike
Science	Like	Dislike
Social Studies	Like	Dislike
School (in general)	Like	Dislike

Thank you for participating in this study.

Appendix C

Q-Sort and Draw-A-Scientist Protocol

Q Sort Instructions

[In this pilot study, the survey procedures were be conducted by the researcher]

Script

Before you, you each have a set of 12 stickers and four cards. The stickers have been printed with the names of 12 science occupations. Your job is to sort the stickers into piles on the the cards according to your interest in these occupations. First, please read all of the stickers. [wait 30 sec.]

Please pick three of these occupations which you would have no interest in and place them in a pile on the card with the word None printed on it.
[wait one minute]

Please pick the three occupations which you have highest amount of interest in and place them on the envelope which has High printed on it.
[wait 30 sec.]

Next, select the three of the remaining six occupations that you have more interest in than the other three and place them onthe card which has Medium printed on it and the rest on the card printed Low. [wait 30 sec.]

Finally, please stick each sticker on its respective card.
These will be collected with the other materials.

The Draw-A-Scientist Test

In the next seven minutes, I am asking you to find the image of a typical scientist in your mind and draw a picture of that scientist on the back of your questionnaire. This picture may be of any kind of scientist you want to draw and you may include any other materials that are needed by that scientist.

[Do not walk around the room. Stay in one place. Please try to maintain an official looking appearance at all times and try to maintain the ability of each child to operate independently]

[Be certain that all materials are collected together and that the names on the cards match the names on the questionnaires.]